DEPARTMENT OF ECOLOGY

October 16, 2003

TO: David T. Knight and James Bellatty
Water Quality Program, Eastern Regional Office

FROM: Jim Carroll, Watershed Studies Unit
Environmental Assessment Program

THROUGH: Karol Erickson, Unit Supervisor, Watershed Studies Unit
Environmental Assessment Program

SUBJECT: RESPONSE TO REVIEW COMMENTS ON THE DRAFT MOSES LAKE TOTAL MAXIMUM DAILY LOAD PHOSPHORUS STUDY TECHNICAL DOCUMENT

The draft technical report, entitled Moses Lake TMDL Phosphorus Study, was distributed to the Moses Lake Advisory Board and interested parties the week of November 25th, 2002. At the Moses Lake Advisory Board meeting in Moses Lake on December 12th, 2002, the technical information in the document was presented and a comment period deadline of December 31st, 2002 was announced for reviewers of the draft technical report. Ecology received written review comments from Jim Parsons (Troutlodge, Inc.), Jack Rensel (Rensel and Associates on behalf of Troutlodge), Anne Henning (City of Moses Lake), Larry Gadbois (US EPA), William Riley (Big Bend Economic Development Council), and Dean White (Lincoln County Conservation District) within the deadline period. Jim Parsons of Troutlodge, Inc. sent additional comments on January 7th, 2003 after receiving a deadline extension for that date. Additional comments were received from Jack Rensel (Rensel Associates) on January 10th, 2003, presumably on behalf of Troutlodge, Inc.

Ecology also contracted with Professor Emeritus Dr. Eugene Welch (University of Washington), who has extensive experience with water quality issues on Moses Lake, to peer-review the technical draft. His written comments were received January 13, 2003.

**General Final Response:**

We believe the collected work completed for this project meets accepted standards for environmental regulatory modeling. The current model (as calibrated) can be used to determine the impact of point and nonpoint source loading of phosphorus to Moses Lake in regards to meeting a 50 ug/L in-lake total phosphorus criterion. Specifically, the model results show that the current load of phosphorus to the lake is too high to meet an in-lake criterion of 50 ug/L during May through September critical conditions.

Beginning with Dr. Welch's, the reviewing comments are listed below (as italics text) with our responses following each specific comment.

**Comments received by peer-reviewer Dr. Eugene Welch on 1/13/03:**

- *General*

  *The report is thorough and generally clear and well written. Assumptions about flows, hydrodynamic processes, critical flow year, partitioning of the lake, etc., are well justified and reasonable and calibrations with temperature and Cl confirm that. While use of such a complex water quality model just to predict TP is not justified, because there are no observational data to verify the myriad rate constants that were adjusted in calibration, the TP results are nonetheless reliable, assuming internal loading and settling rates are reasonable. A table of constants and basis for changes during calibration should be included in the appendix. More direct comparisons of 2001 data with past values would be helpful. More specific comments follow.*

Ecology believes that the use of CE-QUAL-W2, although complex, is essential to our development of a TP TMDL for Moses Lake because the hydrodynamics play a large part in the fate of P in the Moses Lake system. Additionally, the model allowed Ecology to assess the fate of P in the whole lake, not just portions of the lake as earlier models. Ecology is committed to protecting the entire lake from water quality degradation. All rate constants used in the model conform to published ranges used in other CE-QUAL-W2 applications that have been applied successfully in hundreds of cases world-wide. A separate calibration document has been completed that documents the calibration of the Moses Lake model and will be made available upon request. While it may have been interesting to compare the current assessment of the lake with historical data, the technical document met a specific project goal and was not meant to be a synthesis of all water quality work conducted on Moses Lake to date. The project goal was specifically to "…assess the assimilative capacity of Moses Lake with respect to the in-lake proposed TP criterion of 50 ug/L. Data were collected and used in this assessment. A TP allocation plan is recommended to achieve the in-lake TP criterion."

- *p. 1, lines 23-24 – most accurate to say that TP limits biomass (i.e., sets upper limit), while growth rate is a function of soluble nutrient concentration, either N or P, on short term basis.*

Changed the text to read "…managing TP to control algal biomass is supported in the literature, even for lakes where nitrogen may be temporarily limiting the growth rate."

- *lines 3-4 from bottom – UW work went through 1988, so late rather than mid 1980s and historical work is 14 years old, not 20. Same comment for 1st para in abstract.*

Changed the text to read "…now 14-20 years old.", and the abstract to read "last intensive water quality study of Moses Lake was completed in 1988…"

- *line 1 from bottom to top p. 2 – state more accurately, "all incoming loads" were addressed for 12 consecutive years, 1977-1988, so word as "…incoming loads separately and did…set a maximum incoming load of TP to achieve a lake wide goal of 50 ug/L.." May be useful to stipulate that the 50 ug/L criterion is really for a worst-case year of no dilution – both here and line 9 of abstract. Also, the 50 ug/L suggested in 80s was a surface water concentration, not a whole lake; setting 50 for whole lake means that the surface water, or epilimnetic concentration is lower (see model section for more on that).*

Deleted this section of the text from the report.

- *p. 2, line 17 – stick with TN, TP, etc. throughout as defined on p. 1. Reference the historical publications to let the reader know the sources, e.g., line 9 – they are not likely to search out the 2000 report.*

Changed the text to "TP" and "TN" throughout. Added following references: "…Welch et al. (1989;1992), Jones and Welch (1990)".

- *p. 2, last para – the lake has received more than attention and studies – would be useful to state here under history that a routine pattern of addition of low-nutrient Col. R. water was started in 1977 with relatively high volumes during most of the past 15 years. Fig 31 could well go here to reinforce that. While the USBR might say now that their normal route is through ML, that was not the case in the late 60s and early 70s. There was great resistance to putting water through ML. Convincing USBR and the South District that moving the water through a very polluted ML would not harm their irrigating systems was not easy. EPA failed to convince them in 1968 and "flushing" was abandoned, i.e., not water through the lake on routine basis! The primary route to Potholes was not through ML then. But the South District was convinced in 1976 that the process was really "dilution", not "flushing", and a more or less routine pattern of transfer through the lake began in 1977.*

Noted but not included in the text.

- *p. 3 – Stipulate for a non-dilution water year when the 50 ug/L criterion is stated.*

The 50 ug/L TP criterion is for any year, but allocations are being recommended in order to meet the criterion during a critical condition, in the case at Moses Lake, a low-dilution water year. This is discussed further in the report.

- *p. 5 – Looks like ML 1, ML 2, ML 4, ML 5, ML 6 conform to stations 12, 8, 7, 5, 9 and 10, respectively, from UW work. Would be useful to state that to alert the reader that sampling continuity was intended. RF0, CC1, CC0 and RC1 are same as 13, 3, 4 and 2 for UW work. Someone might want to revisit the data.*

Ecology did sample at historical sampling sites to provide continuity with earlier work. Will add statement to text.

- *Line 6 from bottom – from how many depths were water samples collected for lab anal., chl, TP etc.? Apparently Secchi depth was not measured. Unfortunate, because it is the most widely used and reliable piece of limno data!*

Changed the text to read: "Secchi depths were measured at lake stations. Water grab samples were taken at 3 meter intervals from the surface to the bottom…..".

- *p. 7, bottom – Not clear how model was used to estimate tributary loads. Load (conc X flow) does not show up in the model. Is this model to determine the distribution of concentration with flow and time and that result is used to determine load?*

Ecology did use this model to determine the distribution of concentration with flow and time, which was input into the model.

- *p. 8 - Need appendix of actual model formulation and what state variables and rate coefficients were used and some justification for assumptions and calibration changes.*

Ecology has separate documentation discussing the calibration of the model available on request.

- *p. 12 – SRP is preferred over ortho-P in the limno literature; method measures > ortho-P. TP is often redefined and often spelled out in spite of being defined in introduction. Once is enough – use TP and other abbreviations throughout.*

Ecology's laboratory method EPA 356.3 is for the measurement of orthophosphate. Not changed in the text.

- *Line 8 from bottom – "….TP results for Sept 24-26.."? Were filters held in DI water overnight before filtration? P from filters can often give SRP>TP.*

Ecology's laboratory experienced a problem with their in-line digestion for their automated TP analysis.

- *Line 3 from bottom – "…between the two P partitions at the station in question…"*

Changed the text to read: "…shown between the two phosphorus partitions at the station in question…".

- *Table 4 – A blank of 5-10 ug/L is too high for P - should be ± 1 ug/L. Shows contamination of DI water.*

Ecology unfortunately had a reporting limit of 10 ug/L for TP. The blanks were listed as not detectable at the reporting limit. It should be noted that the model does not use TP as a state variable. Ortho-P had a reporting limit of 5 ug/L and was used as state variable in the model.

- *p. 15 – add "…1987 to retain P from entering the lake and carp from entering the creek"*

Changed the text to read: "in 1987 to retain phosphorus and prevent carp from entering the creek."

- *p. 17 – para 2 – This states limits were recommended even though not feasible? Is that correct? Or, DO/pH control in creek not feasible by setting nutrient limits?*

Deleted this portion of the text.

- *Line 14 – The 12 years loading data in Jones and Welch 1990 (excluding wastewater) shows mean of 40% of RFC. How many historical years were used and was wastewater excluded to compare with current situation? This loading was not annual, which is stated online 14.*

Ecology calculated historical annual loading data using the USGS flow record for Rocky Ford Creek (up to 1998) to calculate mean monthly flows and concentration data reported up until 1989 to calculate mean monthly concentrations. These were compared to other annual loads, including wastewater.

- *p. 19 – Might state here that historical TP loading calculations were based on flow at the USGS gauging station.*

Noted but not changed in the text.

- *p. 20 – What kind of "plants" choked the channel – filamentous algae or rooted plants. Makes a difference, because algae respond most to nutrients in the water and rooted plants to water level and substratum.*

Changed the text to indicate "rooted plants", though there is filamentous algae and periphyton in the creek as well. The late 1990s had extensive flooding in the creek which resulted in extensive rooted plant growth. These conditions did not exist in 2001.

- *p. 21 – 18C is understood ungeit style; also 10AM*

Style noted and changed for the time unit.

- *p. 23, line 5 – "…late afternoon observations…" line 8, period not year.*
  *RFC is a trout stream and diurnal DO range of 2.6-9.2 is not a healthy situation, because fish growth is dependent on the daily minimum not the mean or max.*

Rocky Ford Creek is on the 303(d) list for dissolved oxygen, pH, and temperature violations.

- *p. 24, para 1 – Diurnal DO problem is probably due more to periphyton on rocks and plants rather than to macrophytes per se.*
  *para 6 – Chl measured in water was probably sloughed from periphyton mats, which did the nutrient assimilation, not the measured sloughed material. Discussion of this is a little confusing.*

Changed the text to read: "the major contributor of chlorophyll *a* (i.e., algae) to the creek (38.7%), most likely sloughed from periphyton mats…..".

- *Table 5 – Units not indicated.*

Changed the format of the table to indicate units better.

- *Tables 8 and 9 titles could more clearly indicate the difference in sampling location; Sept '01 sampling (Table 9) shows 30% increase in TP load from hatchery, while Table 8 shows 35% increase (11.5/8).*

Footnoted the title of Table 9 to indicate the difference in sampling location.

- *p. 29 – Was "significance" tested statistically or only by comparison of increase with variation? Term significance usually implies stat. Test.*

Changed the text to delete "significant"

- *p. 31, para 3 – Again, the term significant is given wo/ any prob. statement. Ratio is 0.75, not 75%; nitrate + nitrite?*

Changed the text to read: "There were no significant differences ($\alpha$ =0.05) between the upstream and downstream sites for TP….". Changed "ratio" to "percentage".

- *p. 32, line 1- "….oxygen depletion, than a direct adverse effect on trout per se".*

  *Line 8 – "preserved"?*

Changed the text to include suggestions.

- *p. 34, last para (Fig 17) – This constant relation of TP load w/ flow may suggest that contribution from the hatcheries or other sources have not changed.*

Ecology agrees, though in-creek sources have probably changed over time (e.g., hatcheries have probably had different production over the years).

- *p. 40, para 4 – Weinmann, Horner (UW), Bain, et al. conducted a basin-wide loading analysis w/ Dick Bain when at Brown and Caldwell; see NALMS proceedings ~ 1984 – may be earlier.*

Changed the text to read: "Horner et al. (1985) examined Crab Creek during a median flow year (winter-1982-83) and found limited contributions from the upper Crab Creek watershed above Brook Lake to Moses Lake. Although Lincoln County Conservation District has conducted limited nutrient sampling of the upper watershed, a more detailed source study of TP in the upper watershed would be beneficial during a high-flow event (greater than 500 cfs)."

- *p. 41, para 4 – Should be worth mentioning the decline in CC TP and SRP since 69-70 means of 119 and 32, respectively. That has benefited the lake. The irrigation method switched from largely ril to largely spray during the 1970s.*

Changed the text to include: "which was greatly reduced from a mean of 32 ug/L in 1969-70."

- *p. 46, last para – This is first mention of method detection limit for P; these are too high – the lab is obviously not using a 10 cm cell, which is necessary for lake work. This procedure would be useless in majority of WA lakes, which are oligotrophic. So what values were used in load calculation when below detection, the detection limit?*

Agree. The Department of Ecology now has reporting limits of 1ug/L for TP and 3ug/L for ortho-P. They had not changed methodology for the 2001 Moses Lake work. In any case, the CE-QUAL-W2 model uses dissolved P as the state variable which was the lower of the reporting limits at time, ranging from 3 to 5 ug/L.

- *p. 49, para 4 – There is no credibility given here to the initiation of greater feeds through Moses Lake starting in 1977 for purposes of dilution (see comments for p. 1). Fig 31 shows that prior to 1977 there were two years only when sizable amounts were passed through the lake. Until the USBR and South District were persuaded in 1976 to allow more through – and WQ would not be degraded – most flow went around ML. The change in routing was why Brown and Caldwell got the EPA grant to evaluate dilution effects.*

Ecology understands from the Bureau of Reclamation that the initiation of feed water through Moses Lake in 1977, while convenient for a dilution program, was initiated in order to facilitate the conveyance of more irrigation water to the expanding South District.

- *p. 50, Fig 31 – A scale on right for 106 m3 would help, since most of report is in metric.*

Ecology used metric figures when possible, but certain numerical values only have meaning within the Columbia Basin Irrigation Project based on units of acre feet so they were left intact for this report.

- *p. 53, line 1 – Greatly improved water quality would be more accurate? Document the comparison with 1986-1988 values for South L and Lower Parker (DOE 3 and 4) – 44 ug/L TP in 80s versus ~20 ug/L in 2001.*

Changed the text to read: "…Moses Lake had greatly improved water quality during the 2000-01".

- *p. 56, para 2 – Term population refers to one species; algal biomass is more accurate. Useful to make the point that >60% of biomass in mid to late 80s was blue greens at 3 and 4 (Welch et al. 1992). Fig 37 is difficult to read, i.e., blue green fraction.*

Changed the text to read, "…summer biomass…" Historical significance of bluegreens in Moses Lake is referenced in the next paragragh.

- *p. 58, line 3 – Experience high algal biomass; line 10 – algal biomass or sp. composition, not population; para 4, line 1 – no verb; line 5 – "…criterion of 50 ug/L during a worst-case, no dilution year."*

Changed the text to read: "…continued to experience high algal biomass…"; added:"… was used…."; and added, "during a worst-case, little dilution year."

- *p. 61, Fig 39 – Abscissa legend should be X 10-6.*

Corrected the legend.

- *p. 62, line 5 from bottom – Equilibrates rather than re-initializes. Last para – The basis that was used to change coefficients should be included in the appendix table.*

Changed the text to read: "…lake equilibrates quickly with the relative large hydrologic input from the boundaries." Separate documentation is available on request which describes the model calibration.

- *p. 77, para 3 – Aerobic P release also occurs from decomposition of surficial sediment organic matter related to temperature and from loosely sorbed P; aerobic release was determined from ML sediment in laboratory indicating one or both of these processes. Contained in UW thesis by V. Okereke in mid 80s.*

The mechanism of increased P release seems distinct to a specific period of time when there is an increase in pH from the vernal diatom bloom. Though temperature related, a general aerobic release from the sediments would probably not be as temporally constrained, and is most likely included, though not mechanistically, in the calibrated anaerobic P release.

- *p. 86 – Need to justify use of predicted TP for TP budget rather than observed TP. Table 14 – The difference between internal load in '01 and the 80s should be discussed.*

*According to '01 mass balance, the lake was a net sink for P (-1718 kg), while in 1988, there was a net internal load of 12, 467 kg. Although high, that was not the highest internal load. Only in 1978 and 1980 (Mt. St. Helens ash) was there no net internal loading. The reason is not due to an underestimate of ground water load in '88, which was about twice the estimate as 2001.*

Predicted P from the model was used to develop the TP budget because the modeled TP accurately portrayed the spatial and temporal distribution of P in Moses Lake which was the reason why we used the hydrodynamic model. The calibrated model provides greater resolution than just using vertical profile sample data.

There appeared to be less internal load in 2001 than in earlier years. Whether this was from the particular meteorology of 2001 (i.e., less mixing), or a reduced sediment component because of successive years of dilution and reduced productivity, or successful reduction in external loading, or a combination of all these events remains unknown.

- *p. 89-90 – Hypereutrophic is not hyphenated. First para – Identify 50 ug/L wo/ dilution water. Last line – Cell washout rate extremely small (i.e., lake flushing rate) compared to growth rate, so dilution of TP is the big effect.*

Hyphen was taken out. Changed the text to read: "Exchange rates can be high enough to effectively dilute the nutrient concentrations in the lake (when using low-nutrient feed water) and, to some minimal extent, wash out algal cells."

- *p. 91, para 3 – There is aerobic P release as well.*

Changed the text to read: "…however, there can be an aerobic release of sediment phosphorus to the epilimnion."

- *p. 92, last para – Suggest using cms earlier to be consistent.*

Ecology used cfs in the report to reflect earlier reported values. The CE-QUAL-W2 model operates with metric terms only and thus the design criteria are given in metrics.

- *p. 93, para 4 – Suggest giving an equivalent mean lake epilimnetic TP for the whole lake 50 ug/L, because original recommended criterion was for surface water and chl is related to epilimnetic TP, not whole lake TP. As Table 15 indicates, epilimnetic mean TP, which algae depend on, is <50 ug/L, and closer to the EPA recommended criterion.*

Ecology concurs, however, Moses Lake is known to be polymictic and the hypolimnetic P is available to the epilimnion during the growing season in any given year. This is stated in the text as: "When evaluating model simulations, the entire water column TP was averaged for compliance with the TP criterion. Even though the algae grow in the euphotic zone, the entire water column was averaged because Moses Lake is polymictic (capable of mixing several times during the growing season). This avoided the complex task of trying to identify a critical meteorological conditions data set, by conservatively assuming any internal phosphorus loading is potentially available for algae growth. The 2001 year meteorology data were used for the simulation runs." The conservative assumption that hypolimnetic P is available at all times builds in an implicit margin of safety for this TMDL. The epilimnetic response is shown in Table 15.

- *p. 95, last para – Need to emphasize how much internal load has decreased since the 80s, which means external has proportionally more effect now than earlier.*

Changed the text to read: "Apparently internal loading is already suppressed from rates observed since the 1980s."

- *p. 97 and Table 17 – With the 35% reduction in load, the mean epilimnetic TP is conveniently 35 ug/L – in agreement with the EPA recommendation.*

Ecology agrees this is convenient.

- *p. 99 – While bottom water TP is available at times, chl is determined by the epilimnetic TP concentration. For example, the whole lake TP in Sammamish is 22 ug/L, but the amount of algae one gets is dependent on, fortunately, the 12 ug/L TP in the epilimnion. Same situation holds for all lakes. If algae get some of the P from bottom water, then it shows up in the epilimnetic TP concentration.*

Ecology concurs, however, Moses Lake is known to be polymictic and the hypolimnetic P is available to the epilimnion during the growing season in any given year. This is stated in the text as: "When evaluating model simulations, the entire water column TP was averaged for compliance with the TP criterion. Even though the algae grow in the euphotic zone, the entire water column was averaged because Moses Lake is polymictic (capable of mixing several times during the growing season). This avoided the complex task of trying to identify a critical meteorological conditions data set, by conservatively assuming any internal phosphorus loading is potentially available for algae growth. The 2001 year meteorology data were used for the simulation runs." The conservative assumption that hypolimnetic P is available at all times builds in an implicit margin of safety for this TMDL.

- *p. 101, para 1 – Late 1980s (1988 is not mid); para 6 – CC p concentrations did change dramatically since 1970, which is worth mentioning.*

Changed the text to read: "The last intensive water quality study of Moses Lake was completed in 1988…." and "Though Crab Creek TP and ortho-P concentrations have declined dramatically since 1969-70s (attributed to a switch from rill to spray irrigation), May through September 2001 ortho-P concentrations in Crab Creek were slightly higher than those observed in the 1980s."

- *p. 102, para 4 – Internal loading apparently is not as great a limitation as earlier and important to mention that; last para – and reach a mean epilimnetic TP of 35 ug/L.*

Changed the text to read: “Internal sediment release of phosphorus is an important loading source to Moses Lake, though apparently not as important as in earlier years.”

- *p. 103, para 2 – More precise management of dilution water is important for keeping enough TP and algae in the lake to limit expansion of macrophytes. That needs to be mentioned.*

Added the following sentence to the text: “More precise management of feed water may be important for retaining enough TP (i.e., algal biomass) in Moses Lake to limit the expansion of macrophytes in the lake.”

- *p. 104, para 3 – N control was emphasized in mid 1980s and should have been P.*

Ecology concurs. No change in text.

**Comments received from Jim Parsons of Troutlodge on December 5, 2002:**

- *Dear Jim,*

*Thank you for the opportunity to review the draft Moses Lake TMDL Phosphorus Study document. We have a variety of comments that will be presented by Dr. Jack Rensel (unfortunately I'll be at our facility in Chile that week) at the meeting. However, there is one item that I feel is important to clarify prior to this meeting.*

*I was concerned about the feeding numbers when I saw the historical comparison, and this prompted a bit more digging on my part. It didn't make sense that our feed numbers would be down when in fact our biomass was higher than in 1997. In searching the numbers I found that I made a rather large error in calculating feed usage at the facilities for the calendar year of 2001. Our fiscal year runs from July through June, and I incorrectly assumed that we used only one feed supplier during the entire calendar year of 2001. In fact, during the first half of the year we actually received feed from two feed suppliers. The numbers that I gave you ignored this second supplier, as I was using feed purchase records to document our usage on each facility. During the period from January to June we actually utilized approximately 400,000 lbs. of additional feed, bringing the total for the calendar year to 1.25 million lbs.*

*I apologize for this error, but feel it is important to advise you of this prior to the meeting on the 12th. Perhaps if the draft would have been shared with us (as a cited reference) prior to distribution I could have caught this sooner and cleared it up.*

*Best regards,*

*Jim Parsons*
*Vice-President*
*Technical Services*
*Troutlodge, Inc.*

We corrected the feed numbers in the report to reflect the number of pounds indicated above.

**Comments received from Jack Rensel on behalf of Troutlodge on December 9, 2002:**

- *Hi Jim*

- *Here are the TL1 and TL2 biomass values for summer 2002. This is one of three things I wanted to present at the meeting and have permission to discuss. Remember, feed rates can not be applied directly to these as the size of fish (planting fish vs broodstock) have very different rates. I can't tell you what those are for Troutlodge. I simply do not know. You can see that most of the* *summer, TL2 was far less than TL1 although it was increasing, particularly toward the time of your September synoptic survey.*

**Biomass**

| | TL1 P1 | TL1 P2 | TL1 Total | TL2 | total |
|---|---|---|---|---|---|
| **May** | 144,750 | 47,950 | 192,700 | 82,850 | 275,550 |
| **June** | 130,325 | 48,975 | 179,300 | 88,925 | 268,225 |
| **July** | 115,900 | 50,000 | 165,900 | 95,000 | 260,900 |
| **Aug** | 136,400 | 41,200 | 177,600 | 115,500 | 293,100 |
| **Sept** | 116,000 | 40,000 | 156,000 | 119,500 | 275,500 |

- *I did not have actual values for June, so I interpolated for that month. I really don't know if Bill Witt, the on site manager, can resurrect data from other months as it seemed to be a special effort for him to provide these numbers each time I did a field survey.*
- *All the best,*
- *Jack*
- *********************************************************

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Ecology adjusted the P loading for Troutlodge II based on the reduced production at that facility compared to Troulodge I as indicated in the above table. The percent contribution of P from the hatcheries to Moses Lake during the May to September, 2001 time period fell from 9% to 6% as a result. Before this correction, Troutlodge II was assumed to have equal production rates and P loading as Troutlodge I.

**Comments received from Anne Henning of the City of Moses Lake on December 12, 2002:**

- *I just finished reading the report, and noticed a few things that I thought you might want to fix before the final report. I love to edit things, so sometimes I get carried away when I read draft documents, but I tried to stick to only typos and things that really make a difference in what you are saying. Please disregard my comments if you don't think they apply or if my problem was that I didn't understand something. I also had a few questions and general comments.*

*p.7, 2nd full paragraph--Evans 2002 isn't in the References. (I didn't check each work you cited, but I noticed this one because I was wondering what it was, but it wasn't listed).*

The Evans (2002) report was included in the Appendix and is now referenced as such.

- *p.23, under Figure 10, last sentence--doesn't read quite right--Is this how you meant to say it?*

Could not find exactly which sentence you were referring to.

- *p.58, Purpose and Scope--first sentence is a fragment.*

Sentence was corrected.

- *p.64 Chart shows no data for May--Is this correct?*

The field data for that month was questionable. It was unclear from the field notes where the temperature data was collected and therefore was not used.

- *p.91, 2nd full paragraph--I don't think "meterology" is the right term, since you are talking about the physical process and not the science of it. Maybe "meterological conditions" or simply "weather"?*

We agree. Text changed to “meteorological conditions”.

- *p.104, 1st full paragraph--last sentence has an unnecessary "the" before "reducing P"*

We agree. Text changed to delete “the”.

- *It would be helpful for readers like me, who don't deal with all these terms every day, to have an acronym glossary. That way, when I can't remember what RMSE means, I don't have to try to find the first place you used it. Also, depending on the intended audience, a glossary of technical terms might be appropriate. Things like hypolimnion (which I didn't go back and find, so may have spelled wrong) and the word that means mixing (which I can't remember and can't find in the report now that I want it), which your average person wouldn't be familiar with. You did explain those terms as you used them, but I am probably not the only person who forgot and had to track down the place where they were first used. But if your audience is people who would know those terms, then it wouldn't be needed.*

Ecology did produce the technical document with the intention that it would be reviewed by a technical audience familiar with the technical terms and vocabulary, although an attempt was made to make it as readable as possible. We regret we will not be providing a glossary.

- *As I read the report, I wondered if you have coordinated at all with Dave Burgess with Fish & Wildlife. He is doing a study of the lake, for fish habitat. Recently, he was looking at collecting some data at the outfall, which is what made me think of it in the first place. His supervisor is Jeff Korth, who I think is involved in the TMDL meetings.*

Ecology attempted to collaborate on data collection with Dave Burgess of the State Fish & Wildlife during the 2001 study period, but Fish & Wildlife apparently lost funding for the position to collect the data and were unable to collect the data they had planned to.

- *Do you have any thoughts on what would happen if there were dilution water available in a wet year? What would that do to the various forms or P that year? Would the extra water flowing through the system cause problems downstream?*

Actually, one of the modeling scenarios described in the draft technical report predicts that Moses Lake would meet the TP criterion if the median ($50^{th}$ percentile) amount of feed water (dilution) were added to the lake during a $90^{th}$ percentile wet year. However, the Bureau of Reclamation has explained that it cannot deliver that amount of feed water during a wet year because the extra water would violate downstream contractual agreements.

- *I have been working on updating the City's Shoreline Master Program. We have talked quite a bit about requiring vegetated shoreline buffers. Would this have any impact on the nutrient problem in the lake? Or would the buffers need to be so big that it would be unreasonable? (the typical shoreline residential lot is 100' deep and requires a 25' setback from the street. So that leaves 75' for the house and buffer. Right now, we have no required setback from the lake, so people can and do build houses only a few feet from the lake. Even those who don't have a house right on the shoreline typically want a bulkhead across the width of their property.)*

Ecology would encourage any shoreline buffers that would reduce phosphorus inputs into Moses Lake. While the majority of P in the groundwater around the city of Moses Lake appears to be of waste water origin, there is probably over-use of fertilizers and irrigation water on lawns which contribute P as well. Unfortunately, the soils around Moses Lake facilitate quick leaching to the groundwater table which eventually interacts with the lake water, somewhat de-emphasizing the utility of shoreline buffers.

**Comments received on December 17, 2002 from Larry Gadbois of the US EPA:**

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10 HANFORD PROJECT OFFICE
712 SWIFT BOULEVARD, SUITE 5
RICHLAND, WASHINGTON 99352

December 17, 2002

James V. Carroll
Washington State Department of Ecology
Environmental Assessment Program
Olympia, Washington 98504-7710

Subject: EPA Comments on "Moses Lake Total Maximum Daily Load Phosphorus Study", Review Draft Dated November 25, 2002.

Dear Mr. Carroll:

The U.S. Environmental Protection Agency (EPA) has reviewed the subject document. This document was very well written. It presents the technical information in a highly reader-friendly format. The layout is very good, and the writing very clear. Thank you for making review of the information so easy. Our comments are enclosed. If you have any questions, please contact me at 509-376-9884.

Sincerely,

Larry Gadbois

Larry Gadbois
Environmental Scientist

Enclosure

Cc: Marcie Mangold, Ecology's Moses Lake TMDL Project Manager

Printed on Recycled Paper

Mr. James V. Carroll Enclosure December 17, 2002

1) Abstract. 2nd paragraph.
EPA understands that the 50 ug/L target is a high target relative to benchmarks such as:

a) WAC 173-201A-030(6)(a)(table 1) which has 35 ug/L as the highest numeric criteria.
b) EPA, (2001) "Ambient Water Quality Criteria Recommendations. Information Supporting the Development of State and Tribal Nutrient Criteria for Lakes and Reservois in Nutrient Ecoregion III (Xeric West), EPA-822-B-01-008 which recommends a criteria of 35 ug/L
c) TP of 50 ug/L gives a Carlson Trophic Status Index of 60.6 which is considered hypertrophic (EPA, 1999) "Protocol for Developing Nutrient TMDLs", EPA-841-B-99-007, page 4-11.
d) Ecology, (third draft - August 1996) "Nutrient Criteria: review and Analysis for Washington State Lakes", which proposes 35 ug/L as the criteria for the lakes in the Columbia Basin.

The EPA intends to accept that target because it is calculated relative to a 90th percentile worst case year for phosphorus loading from external inputs and a 10th percentile year for diluting flow from Rocky Coulee Wasteway. Based on Ecology's analysis, for about 90 percent of years, external loading will be such that TP would otherwise be substantially below 50 ug/L however internal loading from sediments would sustain the higher TP levels. Thus in most years there would be a net release of phosphorus from the lake sediment. This has the potential over the long term to reduce the phosphorus sink within the sediments. The gradual depletion of the phosphorus from the lakebed sediments under Ecology's proposed TP target would be a good addition to this document. But for depletion of the sediment sink to occur, phosphorus loads need to be controlled year-round, so that off-season loading doesn't accumulate in the sediment. The year-round nature of phosphorus control is not a strong component of the document, and would be a valuable addition to the document as well as the key to long-term water quality. Ecology should ensure that algal mass and TP are monitored during implementation of this TMDL and the data analyzed (a) to ensure that the TP target is met, (b) that 50 ug/L TP is low enough to preserve the aesthetic values of the water, and (c) to document the conclusion of this document that ambient TP levels will usually be significantly lower than 50 ug/L as predicted by Ecology's modeling for about 90 percent of future years. If monitoring data does not support the target selected in the TMDL, Ecology should re-consider the numeric target in light of Ecology and EPA guidance such as cited above.

2) Abstract, last paragraph.
The document states that "specific load allocations for nonpoint sources and wasteload allocations for point sources within each of these major source categories were not established in this study." It is not clear why this statement is in the abstract when pages 103-104 state "watershed-wide 35% reduction of P from these sources is recommended" for diffuse non-point sources, and "the same 35% reduction in P recommended for non-point sources should be applied to the fish hatcheries."

3) Page 95, 2nd last paragraph.
The document states "a Dept. of Fish and Wildlife net pen facility…is only in operation during the winter months, so it does not have a direct impact on algae growth in the summer." This statement can confuse management efforts because the general conclusion in this document is that internal cycling of phosphorus from sediment will maintain relatively high phosphorus levels during the summer. Therefore year-round control of loads/wasteloads is necessary to prevent re-supplying the sediment with phosphorus during the off-season.

Response to comment #1:

Ecology agrees that the TMDL set for Moses Lake should be adaptive in the sense that follow-up monitoring will determine if the proposed strategy is working to reduce water quality degradation in Moses Lake most of the time. Numeric criteria and load allocations should be reconsidered if post-monitoring data shows continued exceedances.

Response to comment #2:
The last sentence of the abstract was misleading and was deleted.

Response to comment #3:
It is true that year-round loads are involved with supplying P to the sediments. Winter time loading sources such as the net-pens, waterfowl wintering on the lake, and winter runoff in the tributaries are examples of possible sediment loading. Reducing inputs from these sources would reduce the P to sediments. The technical report recommends monitoring the Crab Creek winter run-off (which happens only ~40% of the years) for quality and source identification. Non-point source control of erosion in the upper watershed is recommended. Waterfowl and net-pens activities take place in the winter. Their impact on the water column chemistry is incorporated in the initial conditions that were measured in the lake in March of 2001. Most of the water is flushed out in April and May of every year so the initial conditions of the water column (from the winter) have little effect on summer growing season. Waterfowl and net pens contributions to the sediments may have a delayed effect on the lake by being released to the overlying water during anoxic conditions of summer. The CE-QUAL-W2 model of Moses Lake has a P-release sediment term in its algorithms. The model dynamically simulates the release of P whenever the dissolved oxygen level drops below 0.1 mg/L in the bottom of the lake. The dynamic P release calibrated very well with hypolimnetic P concentrations observed in 2001. In essence the model is accounting for these sources of P already.

**Comments received on December 23, 2002 from William Riley of the Big Bend Economic Development Council:**

- *-----Original Message-----*
  ***From:** BBEDC [mailto:bbedc@moseslake-wa.com]*
  ***Sent:** Friday, December 20, 2002 4:38 PM*
  ***To:** Mangold, Marcie*
  ***Subject:** Comments of the Moses Lake TMDL*

*Without spending exorbitant amounts of money, the exact cause of all pollutants in the Moses Lake system will never be known. Several things jump out of the report: Moses Lake is a water body that was not naturally created.*

Ecology believes that phosphorus sources to the lake can be relatively defined and that best management practices, some of which are already in place, can be utilized in economical ways to reduce phosphorus loading to the lake. Moses Lake was naturally created by the damming of the Crab Creek with wind-blown sand.

- *The seasonality of irrigation cause the lake to virtually disappear from Nov 1 to the start of irrigation in the following April. This allows full access to the lake bottom for dredging. or for installation of pipes. Orthophosphates and nitrates in the water are fertilizers. The lake water is currently being minimally used to irrigate. This use of lake water to irrigate crops and lawns should be expanded, and the water previously used should be re-routed to the lake. A strategy could be developed to inject BOR water at other points in the lake to flush it, while a system of pipes laid at the lake water could send the denser, bottom water with its pollutants out of the lake, either as a discharge or for irrigation.*

Ecology will work with the Moses Lake Advisory Board to develop a Supplemental Implementation Strategy (SIS) that will identify effective strategies to reduce phosphorus loads into the lake.

- *There is an extensive number of geese, ducks, and other waterfowl, that inhabit the lake and their wastes are in the lake.*

Waterfowl activities take place in the winter. Their impact on the water column chemistry is incorporated in the initial conditions that were measured in the lake in March of 2001. Most of the water is flushed out in April and May of every year so the initial conditions of the water column (from the winter) have little effect on summer growing season. Waterfowl contributions to the sediments may have a delayed effect on the lake by being released to the overlying water during anoxic conditions of summer. The CE-QUAL-W2 model of Moses Lake has a sediment P-release term in its algorithms. The model dynamically simulates the release of P whenever the dissolved oxygen level drops below 0.1 mg/L in the bottom of the lake. The dynamic P release calibrated very well with hypolimnetic P concentrations observed in 2001. In essence the model is implicitly accounting for these sources of P already.

- *The discussion of any action to take regarding the lake should be an evaluation of what is doable, what is the cost, who will pay, and what are the anticipated results. A cost analysis of all proposed action should be done.*

Ecology will work with the Moses Lake Advisory Board to develop a Supplemental Implementation Strategy (SIS) that will identify the most cost-effective strategies to reduce phosphorus loads to Moses Lake.

*William Riley-BBEDC*
*410 W 3rd Ave*
*Moses Lake, WA 98851*

**Comments received on December 31, 2002 from Dean White of the Lincoln County Conservation District:**

*-----Original Message-----*
*From: Dean White [mailto:deanwhite61@hotmail.com]*
*Sent: Tuesday, December 31, 2002 8:51 PM*
*To: Mangold, Marcie*
*Subject: Comments on Moses Lake Technical Reports*

*December 31, 2002*

*Marcie Mangold*
*Moses Lake TMDL*
*Department of Ecology*
*4601 N Monroe Street*
*Spokane, Washington 99205-1295*
*Phone:  (509) 329-3450*
*Email:  dman461@ecy.wa.gov*

*Marcie,*

*The two recently released technical reports on phosphorous in Moses Lake were well done for the most part and I appreciated receiving the CD version of the reports in the mail.  There are some points and clarifications in my mind that I would like to bring to your attention.*

*Comments on the Moses Lake Total Maximum Daily Load Phosphorus Study by Jim Carroll*

- *In the report, there can be some ambiguity over the words "Crab Creek" and what particular section of Crab Creek is being referred to at a given point in the report. Most of the work/sampling done on Crab Creek in the report was done on sites "CC6" through "CC1", which lie on that portion of Crab Creek between Brook Lake and the mouth of Crab Creek at Parker Horn.*

  *From my perspective, this portion of Crab Creek is "Middle Crab Creek". Crab Creek from the headwaters just west of Reardan downstream all the way through Brook Lake is "Upper Crab Creek". Crab Creek below Potholes Reservoir to its junction with the Columbia River at Schwana is "Lower Crab Creek".*

  *As a resident of the "Upper Crab Creek" area, it does make a difference to me when references are made to "Crab Creek" when what is really being referred to here most of the time is "Middle Crab Creek" and the associated irrigated farming area just north of Moses Lake. In other words, this does not include "Upper Crab Creek" and its associated cropland and rangeland most of the time. It is not uncommon for Crab Creek to have no continuous surface flow or no flow at all between Brook Lake and Moses Lake for an entire year or more, as was the case of the study year of 2001 and subsequent year 2002. When there is no continuous surface flow in Crab Creek between Brook Lake and Moses Lake, "Upper Crab Creek" and the Upper Crab Creek watershed do not contribute any phosphorus at all in suspended sediments in surface water to Moses Lake.*

Ecology believes the report clearly states what portion of Crab Creek was evaluated (Figure 1 shows the sample sites for Crab Creek) and distinguishes where the sources of phosphorus originate from within the Crab Creek corridor. "Middle Crab Creek" is not a common designation for the area Ecology sampled.

- *On page 39, the pH, DO and temperature data for all six stations between Brook Lake and Parker Horn (CC6-CC1) are all lumped into the same charts with no symbols identifying which station is being represented for each data point on the charts. I think it would be helpful to see the individual data from each station to see how water quality may change from upstream to downstream here along Middle Crab Creek.*

Ecology sampled from Brook Lake to Moses Lake, however, as you previously noted, there was discontinuous flow between those sites in 2001, and in fact, very little flow at all except at the sites CC1 and CC2. Regretfully, it would not be very instructive to look at any changes in the water quality between the sites because of the discontinuous flow. Most of the data points on Figure 21 are from CC1 and CC2 because the other sites were dry. The data appendix contains all the data if it warrants your consideration.

- *On page 40, it is mentioned that the TP loads in Crab Creek from large winter/spring runoff events are composed of washed out accumulated TP in sediments from the creek channel. I would beg to differ on this point. High flow events certainly do wash out accumulated sediments from the stream channel and from eroded streambanks and carry them downstream into Moses Lake. However, I would guess that during high flow events, a more significant amount of suspended sediments in Crab Creek comes from runoff* *waters from the surrounding uplands and that a significant portion of these suspended sediments does not have enough time to settle to the bottom of creek channel or to the bottom of Sylvan Lake and Brook Lake before it is delivered to Moses Lake. The suspended sediments that do settle out on the creek channel bottom most likely were delivered there during the waning periods of late winter/early spring runoff events because this is the only predominate time of the year when there is enough water to carry much sediment load to the creek channel. How would necessary nonpoint controls and improved BMP's on surrounding agricultural lands (mentioned on page 103)significantly reduce the phosphorus load from Crab Creek into Moses Lake if the TP loads in large winter/spring runoff events primarily come from …"washed out accumulated TP …in the creek channel"?*

It is Ecology's understanding that the large run-off events in Crab Creek occur when there is a significant rain event in the upper Crab Creek watershed at a time when the ground is still frozen. Sheet run-off occurs during these frozen conditions allowing a large amount of run-off water to reach the creek channel quickly. The channel is quickly inundated and flooding occurs. The force of the water scours and erodes the stream bed of any accumulated sediments, suspending them in the flood water en route to Moses Lake. In this case, the surrounding uplands are not losing soil because it is frozen in place, relatively. However, the surrounding uplands are surely the origin of the sediment in Crab Creek. Erosion occurs with rain events during unfrozen ground conditions, however, these simply do not have the flood magnitude or potential as rain on frozen ground. Any work towards reducing erosion in the uplands throughout all seasons will help reduce the amount of phosphorus load reaching Moses Lake during a flood event.

- *On page 86, the pie chart in Figure 60 has "Crab Creek" labeled as contributing 8 % of the TP load to Moses Lake. What this 8 % contribution really represents is the contribution from "Middle Crab Creek" because there was no continuous surface water flow from Brook Lake to Moses Lake in 2001.*

Ecology agrees and believes the text supports this assertion.

- *On page 101 in the second to last paragraph, it is mentioned that as of 2001, TP and ortho-P concentrations in Moses Lake have not been significantly reduced even though restoration measures such as the retention pond on Rocky Ford Creek and agricultural BMP's in the "Crab Creek basin" had been implemented. What time period and what area are being referred to here? Is this the time period between the mid 80's and 2001 in the irrigated farmland area around "Middle Crab Creek"?*

  *Although there is still room for improvement, farming practices have steadily improved since the 1950's and have greatly reduced the amount of soil erosion, spring runoff and flooding occurring along all sections of Crab Creek compared to the 1920's and 1930's, for example. Many landowners who have participated in Watershed Planning for WRIA #43 have mentioned in meetings that you just don't see the spring runoff floods along Crab Creek that they experienced when they were kids in the "good old days". This makes me wonder if significantly larger amounts of sediments were carried by Crab Creek into Moses Lake during high flow events in the first half of the 20th Century compared to today.*

The reference to page 101 of the draft that we understand you are referring to now says: "As of 2001, there is no indication that TP and ortho-P concentrations in Rocky Ford Creek have changed from measured historical concentrations, suggesting that the mechanisms of anthropogenic contamination of phosphorus are the same as before and that restoration measures applied to date, including the detention pond on Rocky Ford Creek, have not succeeded." The unchanged TP and ortho-P is in reference to Rocky Ford Creek and not Moses Lake and is comparing concentrations in 2001 to earlier concentrations measured in the past 40 years. Furthermore, the report goes on to say about Crab Creek: "Though Crab Creek TP and ortho-P concentrations have declined dramatically since 1969-70s (attributed to a switch from rill to spray irrigation), May through September 2001 ortho-P concentrations in Crab Creek were slightly higher than those observed in the 1980s." The concentrations compared here are from Crab Creek near the mouth of Moses Lake during the summer time low flows. Ecology was not able to sample a high flow event in Crab Creek during 2001 because there was not one. Ecology recommends that a high flow event be sampled in the future as per the recommendations section of the report. Ecology will work with the Moses Lake Advisory Board to develop a Supplemental Implementation Strategy that should include a plan for sampling a high flow event in Crab Creek.

- *On page 102, an across the board 35 % reduction in TP loads for all sources of phosphorus to Moses Lake is recommended for a critical design year with a 90th percentile load (during a high flow year). Is this really a fair and equitable method for load reduction allocation? If Upper Crab Creek only has high flow years 40 % of the time and assuming that phosphorus from Brook Lake does not contribute to the high TP levels in Rocky Ford Creek, shouldn't Upper Crab Creek be given credit for the 60 % of the time that it is not contributing very much if any phosphorus to Moses Lake? After all, Rocky Ford Creek and direct groundwater inputs deliver a higher overall level of TP to Moses Lake all year long, including summertime when available phosphorus is most readily converted into problematic algal blooms.*

Ecology did not include a 35% reduction in P from upper Crab Creek in its allocations. Allocations were given to May through September controllable P load inflows to Moses Lake only. However, Ecology does recommend an assessment of the P loads from upper Crab Creek and strategies to reduce that P load. A reduction in upper Crab Creek P load during a high flow year will reduce the P mass in the lake leading to more favorable initial conditions at the start of the growing season (May to September).

*Sincerely,*

*Dean White*
*Water/Soil Resources Technician*
*Lincoln County Conservation District*
*Phone: (509) 725-4181 ext 3*
*Email: dean-white@wa.nacdnet.org*

**Comments received on January 7, 2003 from Jim Parsons of Troutlodge, Inc:**

*Comments to DOE – Jim Carroll*
*Moses Lake TMDL Phosphorus Study – Draft Report*

*1/7/03*

*Jim Parsons – Troutlodge, Inc.*

*Dear Jim,*

*Thank you for the opportunity to comment on the Draft Moses Lake Phosphorus TMDL report. Listed below, in no particular order, are several points that Troutlodge (TL) feels are relevant and should be dealt with in future versions of this document.*

1. *As previously noted by email, the feed amounts for the TL facilities provided to you were faulty. As a result of this, and the lower loadings on the TL 2 facilities as reviewed with you by Dr. Rensel, the efficiencies of both TL hatcheries are higher than suggested, and the overall contribution to Moses Lake phosphorus lower.*

2. *TL remains concerned about the extremely high background levels of TP in the source springs to Rocky Ford creek. There seems to be much confusion as to the origin of this high phosphorus content. If indeed anthropogenic in origin, TL believes that this must be addressed as it represents a potential threat to the nature of our business. We suggest that additional studies to further define the source are called for before any adequate TMDL can be presented.*

3. *DOE recommends a reduction of 35% of all sources of TP to the lake in order to meet the proposed water column concentration of 50 ug/l. However, no analysis that has been presented shows that a reduction to that level will affect a change in beneficial uses of the lake.*

4. *A 35% reduction of TP lading at the TL facilities would not be economically or technically possible. In fact, this suggested reduction is far below that requested of Idaho trout farms in the middle Snake River of Idaho, where net concentration limits of 0.082 mg/l have been proposed. TL's net TP concentrations are currently well below these guidelines. Additionally, assuming a 6% contribution of TL to the TP in Moses Lake, such a reduction would amount to an overall reduction in the lake of around 2%.*

5. *DOE's plan calls for a reduction from TL facilities that might at best yield an overall 2% improvement, but 95% of the remaining sources are left to be handled by BMP's and non-point controls that remain undefined. The eventual success of these other controls are much more important to the overall effects on Moses Lake, but are not dealt with directly by this plan. TL suggests that until inputs from Crab Creek and other instream inputs are dealt with, it makes little sense to propose such a restrictive TMDL plan.*

6. *Dissolved oxygen concentrations downstream of TL facilities are most likely due to instream macrophytes. In previous years, the TL2 facility had to utilize supplemental oxygenation for the early morning hours due to the high macrophyte loads in the stretch of Rocky Ford creek between the facilities. There is no evidence to suggest that the*

*presence of the trout hatcheries is the sole, or even major cause of this problem. High concentrations of nutrients in the insource water would lead to high plant growth, and subsequent low DO's and pH without the presence of the TL facilities. Lack of cause and effect data suggests that removal of this inference from the report is warranted.*

*I would be happy to provide further inputs on any of these issues should you need additional information.*

*Sincerely,*

*Jim Parsons*
*Vice-President/Technical Services*
*Troutlodge, Inc.*

**Ecology officially responded to the comments above by Troutlodge, Inc. as follows:**

Response to comments to DOE
Moses Lake TMDL Phosphorus Study – Draft Report
Received: 1/7/03

To: Jim Parsons – Troutlodge, Inc.

Dear Jim,

Thank you for your comments on the Draft Moses Lake Phosphorus TMDL report. Jim Carroll and I have worked together to respond to your comments. Before we address your comments, we would like to explain parts of the TMDL process that will provide you some background information.

Often in the TMDL process, especially in TMDLs primarily from non point pollution, sources are not known at the beginning of the implementation planning. It is difficult to pin point the exact source and frequently there are various sources contributing to the problem. In the case of the Moses Lake TMDL, it will be documented that exact sources are not known and that further investigation would be useful. The goal as suggested by Jim Carroll in his technical report is to proceed with a 35 % across the board reduction in phosphorus to the Moses Lake watershed. It is expected that if the various sources can meet this reduction then Moses Lake will be protected for its beneficial uses.

We anticipate discussions regarding the need for future monitoring and source identification. As we proceed into the Summary Implementation Strategy (SIS) step of the process, it is important to remember that this is just the first step in implementation. The SIS is an outline or "idea list" of what things need to be done to reduce the phosphorus. Some of the strategies in the SIS may include future monitoring for source identification which will further help the implementation process. Other strategies are Best Management Practices (BMPs) that are already in place. Due to your experience in management and operations, many or your BMPs will be added to the SIS.

In order to give you a overall picture of the TMDL process and how EPA is involved we would like to explain some guidelines that we must follow as they directly relate to you.

> EPA states in their "1991 Guidance for Water Quality-based Decisions: The TMDL Process" (page 15) that "Under the [Clean Water Act], the only federally enforceable controls are those for point sources through the NPDES permitting process. In order to allocate loads among both non-point and point sources, there must be reasonable assurances that non-point source reduction will in fact be achieved. Where there are not reasonable assurances, under the CWA, the entire load reduction must be assigned to point sources. With the phased approach, the TMDL includes a description of the implementation mechanisms and the schedule for implementation of non-point source control measures."

In the event that successful non-point controls cannot be established with reasonable assurance, there would be no capacity for any TP loading from any permitted discharges (i.e., zero allocation).

We are hopeful that the combined efforts of the watershed interests working to reduce phosphorus will lower both point sources and non point sources to an acceptable level. Ecology feels that the 35% across-the-board reduction is an initial allocation strategy that favors fair participation from all those responsible for TP loading to Moses Lake. This strategy supports a process where everyone is a partner in the clean-up actions. Across-the-board participation encourages a solution-based, proactive response from all local stakeholders.

We have listed each of your comments below, followed with our response. Please note that some portions of the comments may have been addressed in the previous paragraphs.

1. As previously noted by email, the feed amounts for the TL facilities provided to you were faulty. As a result of this, and the lower loadings on the TL 2 facilities as reviewed with you by Dr. Rensel, the efficiencies of both TL hatcheries are higher than suggested, and the overall contribution to Moses Lake phosphorus lower.

We understand that the feed amounts you provided us were incorrect. Jack Rensel did provide me with updated 2001 biomass numbers for both facilities which I used to calculate a new overall P contribution to Moses Lake. The overall hatcheries contribution dropped from 9% to 6%.

2. TL remains concerned about the extremely high background levels of TP in the source springs to Rocky Ford creek. There seems to be much confusion as to the origin of this high phosphorus content. If indeed anthropogenic in origin, TL believes that this must be addressed as it represents a potential threat to the nature of our

business. We suggest that additional studies to further define the source are called for before any adequate TMDL can be presented.

Although the Moses Lake technical documents do not identify the origin of high P in Rocky Ford Creek springs, a TMDL for Moses Lake will still proceed. As noted above a SIS is the first step in the TMDL implementation process and will contain strategies for P reduction, which may include recommendations for further studies or identification of sources.

Ecology did ascertain that the bulk of the spring water during July of 2001 was most likely from irrigation recharge in the Adrian sink area (between Brook Lake and Rocky Ford Creek springs); however, it is uncertain if this recharge is the source of high P. This could be addressed by a review of agricultural P management for that area, with subsequent recommended BMPs, a sampling program, or both.

3. DOE recommends a reduction of 35% of all sources of TP to the lake in order to meet the proposed water column concentration of 50 ug/l. However, no analysis that has been presented shows that a reduction to that level will affect a change in beneficial uses of the lake.

EPA mandates that the TMDL establish a TP criterion for Moses Lake. State of Washington guidelines as well as EPA guidelines suggest that the TP criterion for Moses Lake be 35 ug/L. We believe that 35 ug/L is too stringent for Moses Lake and not achievable with external controls only. At some point, with external P reduction, the internal loading of P from the lake sediments dominates as the major source of P to the lake. The lake modeling exercises showed that it would be difficult to reduce the lake concentration below 50 ug/L during a critical year ($90^{th}$ percentile flow regime) without internal load controls. Internal loading has been considered uncontrollable for Moses Lake due to the impractical nature of applying internal controls to such a large lake. Historical studies on Moses Lake have established that a 50 ug/L criterion is not only achievable, but would also result in a reduction in excessive blue-green algae blooms.

4. A 35% reduction of TP loading at the TL facilities would not be economically or technically possible. In fact, this suggested reduction is far below that requested of Idaho trout farms in the middle Snake River of Idaho, where net concentration limits of 0.082 mg/l have been proposed. TL's net TP concentrations are currently well below these guidelines. Additionally, assuming a 6% contribution of TL to the TP in Moses Lake, such a reduction would amount to an overall reduction in the lake of around 2%.

(The reductions listed in the report are recommendations based on a simple assessment of how much loading would need to be reduced across all sources to meet the proposed criterion. However, an alternative list of reductions can be determined as part of the SIS as long as the total load reductions would meet the in lake criterion. Ecology's regional office together with the Advisory Board will need to determine what management practices might reduce loading to the system. We expect that EPA will not approve the TMDL unless some reductions from the point sources are included in the SIS.) (added text not in original response)

An Ecology report, "Quality and Fate of Fish Hatchery Effluents During the Summer Low Flow Season" (Kendra, 1989) reviewed the then-current BMPs and some of the recommendations that may prove helpful in reducing phosphorus concentration. This publication is available on line at http://www.ecy.wa.gov/biblio/8917.html or it can be ordered from our Publications Office at (360) 407-7472.

We would also like to suggest optimizing feed formulations (low-P feed). During our sampling surveys we also noticed that the hatchery waters were not shaded. Shading would limit phytoplankton and epiphyton production in the facility, and maintain cooler water temperatures, thus increasing dissolved oxygen saturation.

5. DOE's plan calls for a reduction from TL facilities that might at best yield an overall 2% improvement, but 95% of the remaining sources are left to be handled by BMP's and non-point controls that remain undefined. The eventual success of these other controls are much more important to the overall effects on Moses Lake, but are not dealt with directly by this plan. TL suggests that until inputs from Crab Creek and other instream inputs are dealt with, it makes little sense to propose such a restrictive TMDL plan.

It is important to remember that Ecology has not established any plan for how phosphorus will be reduced in Moses Lake. Over the next couple of months the advisory committee will be developing some strategies to reduce the phosphorus loading. The actual planning stage will begin after the TMDL receives approval from EPA. It will be the advisory committee that will guide the activities which will be implemented to reduce the phosphorus. The other sources, such as failing septic systems and agriculture, will need to be addressed by the advisory group. (However, as mentioned in our response to your comment #4 we expect that EPA will require that some reductions be made in point source loading.) (added text not in original response)

6. Dissolved oxygen concentrations downstream of TL facilities are most likely due to instream macrophytes. In previous years, the TL2 facility had to utilize supplemental oxygenation for the early morning hours due to the high macrophyte loads in the stretch of Rocky Ford creek between the facilities. There is no evidence to suggest that the presence of the trout hatcheries is the sole, or even major cause of this problem. High concentrations of nutrients in the insource water would lead to high plant growth, and subsequent low DO's and pH without the presence of the TL facilities. Lack of cause and effect data suggests that removal of this inference from the report is warranted.

In addition to satisfying the Moses Lake TMDL TP allocations, Troutlodge also must satisfy any allocations that address the water quality violation listings on Rocky Ford Creek which include dissolved oxygen, pH, and temperature violations. Again, if the high concentrations of nutrients in the in-source water cannot be mitigated to an extent that the water quality standards are met, then there would be no capacity for additional permitted loading.

After further discussion and conversations with Dr. Gene Welch, we are under the opinion (without direct evidence right now, but we believe it could be modeled) that the diurnal dissolved oxygen (and pH) problem is more due to periphyton (i.e., attached algae) on the substrate and plants than to the macrophytes per se. Periphyton responds more to nutrients in water, while macrophytes respond more to water level and substratum nutrients. All of my data suggest that the most productive areas in all of Rocky Ford Creek were in the reaches directly below your hatchery returns. The ammonia releases from the hatchery in combination with the dissolved P would provide ready available fuel for such productivity.

We hope these comments have helped to address your concerns. We would be happy to discuss any of these issues in more detail with you at your convenience
.

Sincerely,

Jim Carroll and Marcie Mangold

**Comments received on January 10, 2003 from Jack Rensel of Rensel Associates (Jack Rensel was contracted by Troutlodge, Inc. as a consultant):**

***RENSEL ASSOCIATES Aquatic Science Consultants***

*January 10, 2003*

*Mr. James Carroll*
*Washington Department of Ecology*
*Olympia Washington*
*By Email*

*Dear Jim,*

*Below are my comments on the surface water TMDL report for Moses Lake including Rocky Ford Creek. We have discussed and emailed comments about many facets of the report but I thought it necessary to summarize them here in one place. I appreciate both the quality of the report and the difficulty in preparing it, but there remain some unanswered questions in my view:*

- *Probability estimates of feed water to lake*

  *I remain unconvinced that discharge volume of Columbia River source ("feed") water to the lake via the BOR canal system should include historical data back to 1977. These data were used to estimate overall probability of flows (Figure 5), which in turn drives the water budget and the estimates of how much phosphorus reduction is required to achieve any particular goal. Use of long term flow data would be appropriate if irrigation use and climate conditions were static or fluctuating normally during the selected years. But I do not believe the former to be true and the report does not deal with it in any form. The question of climate change or oscillation is open too, but it seems as climatologists are often unable to discern effect and trends until well after change has occurred.*

  *I believe only more recent years should be used in the probability estimates, not data from several decades ago when use patterns and total volumes were less. I understand there has been increased efficiency in irrigation, but most probably this has been outweighed by the constant increase in total acreage irrigated. Many crops grown in the service area are still profitable and desirable for agricultural interest to pursue, such as high value alfalfa and timothy.*

  *In Figure 31 of the report (page 50) there is an apparent increase of feed water discharge in recent years, with only the relatively wet years of 1996 and 1997 showing major decreases. Flow increase in recent years is likely due to the build out of the irrigation system demand and not solely due to reduced throughput during wet years. The report states (page 95, 2$^{nd}$ para.) that "In the absence of feed water addition, a TP load reduction is necessary to meet the 50 ug/L TP (proposed) criterion". But feed water is added every year, as the flow data shows. There are no known climate trends for the area that suggests an increase in rainfall, so the question remains, will the extreme years such as 1980 that they modeled be more* *frequent than 10% of the time. Looking at the feed water flow data (in Figure 31 on page 50) there were 3 of 17 years since 1985 that had less than the total volume of the lake (assuming 1984 data not available). Only two of these years had relatively low volumes of feed water, and 2/17 = 0.12 or 12% of the time. This is very close to the estimated 10% frequency or "acceptable exceedence probability" used by Ecology in TMDL analysis.*

*In this same context, the report should try to do more to justify the notion that the situation is unchanged in the lake from the 1980s when algal blooms were apparently more frequent and extensive. As your report points out, the 2001 lake data show the lake well within compliance (~33 ug/L) for the proposed TP criterion (50 ug/L) and no major blue green algae blooms. There are no other lake data from recent years as lake monitoring is not done routinely which hampers our ability to understand if the system is static or is actually trending toward improvement.*

*You told me about internal loading and either you or Dr. Welch advised me that this source of P from sediments in summer is no longer a significant factor, as it once was thought to be. Is this evidence of a change, possibly induced by relatively high amounts of feed water in the past two decades?*

Ecology performed a trend analysis on the Columbia River feed additions to Moses Lake for the period of record from 1977 to 2001, the same used to define the feed water addition for a critical flow year. Using WQHYDRO (Aroner, 2001), a graphically-oriented statistical and analysis program for hydrological data, a Spearman Rho trend analysis was performed on the feed water data in two ways. One, directly with the actual annual feed water totals for each year, and two, with a log transformed ratio of feed water inflow to natural inflow for each year. The first way showed a weak increasing trend at only an 80% confidence interval. The second way showed no trend at or above an 80% confidence interval. Ecology believes while build out of the Columbia Basin Irrigation Project has undoubtedly taken place over the time interval, so too has more efficient use of water, negating any significant trend increase (>90% confidence interval) in feed water supply over the time period. Ecology believes the assumptions it used to define the critical flow year are well justified and reasonable.

- *2) Detection limits and changes in feed water content*

*A related topic is detection limits for total P used in this, and all Department of Ecology studies. As I expressed to you on at least one occasion, I am amazed that Ecology's laboratory services continue to provide such poor detection limit data to their clients. A detection limit of 10 µg/L is at least an order of magnitude and perhaps two higher than that available from commercial and academic laboratories. This comes into play in the present project in regards to the feed water which originates from Lake Roosevelt and the Columbia River. I note in the data appendix of the report many "U" symbols, which mean non-detected or less than the above mentioned detection limit.*

*As a result, I am wondering if the feed water concentration of P is less than actually estimated, and as I have pointed out, is therefore significantly less than that which occurred in the water source 20 years or more ago. There is evidence that the Columbia River waters have declined significantly in P loading for several decades, with a particularly large drop in 1995 commensurate with the closing of the Cominco plant in Trail, B.C. that was putting out up to 8,000 kg of P per day into the system and now contributes virtually none. As you know, I have over a decade of low detection limit P data from the Grand Coulee Dam area of the river, and have been tracking this situation for many years. I also know that Ecology's data collection in the same area is spotty which is consistent with a policy of measuring tributary systems, while somewhat ignoring the mainstem except for a few far downstream stations.*

Ecology's laboratory (MEL) reports phosphorus data unqualified down to the method detection limit (MDL). An MDL is determined by analyzing a low-level standard (5-10 ug/L for total phosphorus) seven times and determining the standard deviation of the results. Multiplying the student-t value for this number of samples (3.14) times the standard deviation gives you the MDL. This MDL indicates the lowest concentration that can be determined with a 99% confidence that the analyte is present. Most labs will not report results less than a practical quantitation limit (PQL) which is typically ten times the MDL. Sample results at or above the PQL are expected to meet all usual QA/QC criteria. That is not generally true for results below the PQL. The MEL reporting limit for low level TP is currently 1 ug/L and for ortho-phosphorus it is 3 ug/L.

Ecology is reluctant to report values lower than the MDL, because our data are used to make regulatory decisions and data below the MDL are usually consider noise. In any case, the CE-QUAL-W2 model uses dissolved P as the state variable which was the lower of the reporting limits at the time, ranging from 3 to 5 ug/L. Ecology concurs that if there is decreasing trend in the P content of the feed water, there will be a more effective response to feed water additions in Moses Lake.

- *3) Explanation of phosphorus goals for lake and benefits*

*Another facet of the report is that there is little discussion or explanation on how improving the lake from apparent hyper-eutrophic present conditions to eutrophic condition will result in any tangible benefits and improvement in use to the public. There is so much TP available, from all sources, that the algal bloom situation is undoubtedly controlled more by summer weather than any other single factor. If the summer is wet early on, then turns dry, hot and calm, harmful algal blooms are very predictable. This is not unique to Moses Lake but applies to many other lakes too, and coastal marine waters as well. Nutrients are a necessary factor for blue green algal blooms, but often it is an imbalance of nitrogen and phosphorus that leads to the loss of relatively benign diatoms or green microalgae, which are replaced by undesirable blue-green algae that can produce their own nitrogen from nitrogen gas.*

*The process is slow, but they can fix the nitrogen after other types of algae "crash". In this regard, I do not find any discussion of dissolved N to P ratios and how the blue greens respond to observed changes. I suppose much of this is from historical literature, and not the subject of your report, but some limited discussion seems appropriate.*

Ecology believes that the historical work clearly shows that reducing P in the lake will control algal biomass, regardless of summer weather. The "dilution" program in 2001 (a year that was dry, hot and calm) further showed that reducing P in the lake will control harmful algal blooms. Ecology is mandated to manage Moses Lake to lake class standards, one criterion of which is the establishment of the proposed maximum in-lake 50 ug/L of TP. It is our best professional judgement, based on the historical success in controlling P with the "dilution" program, that a 50 ug/L TP criterion will result in reduced algal biomass even in years without dilution water. Furthermore, the scope of the technical report was not to look at specific algal population response to a reduction in external P loading. That is research question beyond the scope of this work and has been addressed in the historical literature on Moses Lake. The project goal was specifically to "…assess the assimilative capacity of Moses Lake with respect to the in-lake proposed TP criterion of 50 ug/L. Data were collected and used in this assessment. A TP allocation plan is recommended to achieve the in-lake TP criterion." A 35% across-the-board reduction in TP from controllable external sources is recommended to meet the 50 ug/L TP criterion in years without dilution water.

- *4) Uncertainty of ultimate sources of P and likelihood of mitigation*

*As a TMDL is supposed to identify sources of a pollutant, and the report goes a long way to achieving that goal but I believe that there is still some significant unknowns that will hamper effective mitigation.*

*The source of much of the problem near the lake is urban septic drainage, and the chances of fixing that are nil in the short run given economic realities. Even if this was done in the long run, the companion groundwater report notes that there is an underground reservoir of "sorbed P" in the sediments, waiting to be released even if cutback in new P production occurred. This is not a reason to oppose such remediation, but rather evidence that Ecology's future remediation plans are not likely to bear much fruit in any reasonably short time frame.*

*More to the point, phosphorus loads in the Rocky Ford Springs remain high compared to what would be expected from local groundwater, but both reports are vague about the actual sources of such high P loading. It will be difficult and probably impossible to achieve any meaningful change in up slope land management practices that may affect the springs given the uncertainty. The groundwater report suggests that the source may be from anthropogenic sources as far away as the neighboring county, that are fed to porous lakes or streams northwest of the springs.*

*The above leaves very few clearly identified sources of phosphorus that can be quickly addressed, indeed none that are significant in volume. As Mr. Parsons points out in his letter, even if Troutlodge was to reduce discharged P by 35%, it would be a tiny fraction of the loading to the lake (~2%) and certainly not measurable against background variation in the entire system. This is not an argument to avoid reducing P output from Troutlodge, but an acknowledgement that Ecology will have a very difficult time identifying and initiating meaningful reductions of P loading to the lake under the present circumstances.*

Ecology agrees there are unknown non-point sources that will be difficult to ascertain. Ecology often faces these uncertain situations across the state where non-point sources are involved. It seems to be the nature of working with non-point sources. This TMDL will have to have a "roll up our sleeves" commitment to achieve adequate P reduction. The technical report calculates the amount of P that Moses Lake can assimilate and offers a first-cut recommendation (35% across-the-board for controllable sources) to reduce P for a critical season. Most likely, many sources contribute to the non-point P load. It would not be reasonable to exclude any sources from consideration because the constitute only a small percentage, because eliminating or reducing a wide range of small contributing sources will be how the TMDL will be achieved. Troutlodge, as a point-source contributor of P to Moses Lake, will be asked to do their share in reducing P input to the lake.

- *5) D.O. and pH conditions in Rocky Ford Creek*

*The report states on p.104 that nutrient controls on the TL hatcheries "may" address dissolved oxygen and pH problems downstream. I am not convinced that this is the case, and the report does not provide much detail in that regard. Some of the effect could be due to nitrogenous wastes demanding D.O. but the report my experience is that ammonia from fish culture facilities is very rapidly altered to nitrate through nitrification by bacteria. I know this from repeated mass balance measurements upstream and downstream of facilities. It is then curious that the report identifies actual nitrogen uptake from the hatcheries (page 24) results in less nitrate output than intake.*

*As suggested by Mr. Parsons in his letter, the report should examine the likely possibility that early morning D.O. depressions in the creek near the hatcheries are related to algal respiration which normally occurs in the early morning hours before daylight. The report states that the hatcheries were major sources of chlorophyll, and indeed fouling by algae occurs in the raceways, but much of this is removed during the growing season by the more or less continuous cleaning that occurs by hatchery staff. It is more likely that D.O. depressions in the creek are due to combined microalgal and macroalgal respiration and decay, which is in part a result of the good growing conditions and backwaters wetlands that fringe the creek.*

*There is no compelling evidence or argument in the report that advanced treatment or changes in feed will have a significant effect on this D.O. situation. Microalgae will respire most in the early AM hours, not the fish. Macrophytes respire too, but* *tend to do more so later in the season when self shading becomes a problem and $P_g$ and $P_n$ decline. After seasonal biomass maximum is achieved respiration losses increase of course until senescence. For fish, numerous excellent physiological studies of salmonids show their rates of D.O. consumption in hatcheries relate more to time of initial feeding in the late morning and early afternoon, not before daylight when they are least active. Finally, nutrients are so abundant in the source spring water that is is entirely possible that all forms of algae in the upper creek are not limited in any form by nutrients. Other factors such as advection of microalgae by flow and competition for substrate and light by macrophytes are indeed more likely limiting factors. In short, I do not believe the report should implicate the hatcheries in this matter without any plausible evidence or theory.*

Ecology references a summary of the work of numerous investigators who documented water quality degradation downstream of fish hatcheries, including increased downstream algal and periphyton growth and productivity. After further discussion and conversations with Dr. Gene Welch, we are under the opinion (without direct evidence right now, but we believe it could be modeled) that the diurnal dissolved oxygen (and pH) problem is more due to periphyton (i.e., attached algae) on the substrate and plants than to the macrophytes per se. Periphyton responds more to nutrients in water, while macrophytes respond more to water level and substratum nutrients. All of my data suggest that the most productive areas in all of Rocky Ford Creek were in the reaches directly below the hatchery returns (with alarmingly low dissolved oxygen readings as low as 4.3 mg/L observed in August 2001). The ammonia releases from the hatchery in combination with the dissolved P would provide ready available fuel for such productivity. In addition to satisfying the Moses Lake TMDL TP allocations, Troutlodge also must satisfy any allocations that address the water quality violation listings on Rocky Ford Creek which include dissolved oxygen, pH, and temperature violations. If the high concentrations of nutrients in the in-source water cannot be mitigated to an extent that the water quality standards are met, then there would be no capacity for additional permitted loading.

- *6) Potential bias in time of day sampling*

*Most of the data collected for the report at the Troutlodge hatchery, RFC springs and immediately downstream was during the 7 to 9 AM time period. I have conducted studies of major hatcheries where we collected TP and other measures around the clock and found that TP production was at about twice as high in the morning to mid-afternoon, compared to other times of day. A reasonable explanation is that the fish are relatively quiescent throughout the dark hours of the night, but continue to defecate. When feeding is first commenced in the early morning, fish respond with activity bursts that stir up the water. This results in relatively higher output of TP during that time period. Every hatchery is different in configuration and operation, but I suspect this is a real phenomenon at many hatcheries. The report should acknowledge that production rates of P from the hatchery are based on the assumption that P is produced at a steady hourly rate, which may or may not be true. If it is true for these hatcheries, there must be other sources of TP contributing to the calculated loads of P at the mouth of the creek.*

Ecology conducted a synoptic sampling on September 24, 2001, when morning as well as afternoon samples were taken. The morning samples taken at stations RF2A and RF1C (both directly below the hatcheries) were 107 and 126 ug/L, respectively, which was 7 and 4 ug/L, respectively, higher than their counterpart afternoon samples, but well within the 10% precision expected for TP analysis. Troutlodge, Inc. is known to have done more extensive sampling in 2001 and may better be able provide data as to morning and afternoon differentiation of P loading from the hatcheries.

- *7) Miscellaneous comments*

*1) The draft report does not present the actual data used to prepare figures of stream flow, nutrient concentration in the springs or loading values (i.e., the basis for Figures 7 and 16 and Table 6). Although the appendix includes the raw data, I can not recreate the same values for any of these relationships. Some data were rejected or qualified, but we have no way of knowing specifically what was done.*

Ecology did include stream flow data and concentration data in the appendix. Loading values were calculated from this data. Ecology does not include all worksheets in the technical reports in the interest of brevity and not to be cumbersome. Ecology will provide any worksheets or model files used to develop summary data upon request.

*2) Production of orthophosphate assumption. On page 28 Ecology suggests that most P produced by the hatcheries will be in the dissolved form, probably orthophosphate. The literature clearly shows rather that is TP that is produced, fortunately, as TP is much easier to control through sedimentation.*

Ecology measured both TP and ortho-P increases below the hatcheries (compared to upstream values) on September 24$^{th}$, 2001 and the majority of the P increase at both locations was in the dissolved phase (58% and 75%). Ecology is reporting observed data.

*3) Page 31. Reference to "pond", was that a typo, should have been "lake"?*

The "pond" referred to on page 31 of the draft is the retention pond at the mouth of Rocky Ford Creek. There is no typo.

*4) Page 35, Referring to the companion groundwater study, the last sentence of paragraph one is misleading. Yes, anthropogenic sources of P may dominate the Rocky Ford system, but the bulk of the anthropogenic sources are from irrigation infiltration above the springs, not from uses of the creek per se.*

Ecology believes the sentence is clear, that anthropogenic sources of P probably dominate in the source springs.

*5) Page 43. No summary of nutrient data from Rocky Coulee Wasteway (i.e., the feed water) is provided.*

Ecology did provide the data in the appendix.

*6) General comment: The Wiebull diagrams need brief explanation, not the probability part but the rest of it.*

The Wiebull diagrams are simply probability plots. Ecology is unsure what needs to be explained if the probability part is clear.

*Thank you for the opportunity to comment on this report. I appreciate your openness and willingness to entertain my comments and suggestions. I also appreciate your courtesy extended to me in the field work.*

*Sincerely,*

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